

THE BREEDING SEASON OF UNIONIDÆ IN PENNSYLVANIA.

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Since C. T. Simpson published his new system of the *Unionidæ* (Proc. U. S. Nat. Mus. 22, 1900), which is founded, in a large part, upon the "marsupium" of the female, this latter organ must be regarded as one of the most important features of the soft parts of the mussels, and should be known in every species. Yet there is a large number of species, in which it has never been seen by anybody. That certain species are very rarely found with the marsupium developed, is, in my opinion, chiefly due to the fact that they are not easily obtained at the period when they are gravid. As Sterki has first suggested (NAUTILUS, 9, 1895, p. 91), there are *two groups* among our mussels with regard to the period of gravidity¹): *summer breeders* and *winter breeders*. In the summer breeders the short "breeding season" falls into the early summer months (May, June, July); now since many of the species which belong or may belong here are characteristic for the larger rivers, avoiding smaller streams, and since just at this time the rivers very generally are swollen and muddy by copious summer-rains, it is practically impossible to collect them in the gravid condition.

During the summer of 1908 we had exceptionally dry weather in our region; the stage of the rivers in Pennsylvania was already in the beginning of July very low, and thus the writer succeeded in finding several species in a gravid condition, which generally at that season are out of reach. In addition, he has collected other species in the smaller streams at various seasons, and has found gravid females, both of summer and winter breeders. The following is a list of them, which also intends to give the previous records for those species which are found in Pennsylvania:²

¹In order to avoid misunderstanding, I want to state expressly that by "period of gravidity" or "breeding season" I mean the time when the gills, or part of the gills, which forms the "marsupium," are filled with eggs or embryos.

²See: Lea, I; Observations, II, 1838, p. 51 ff.; III, 1842, p. 231; VII, 1860, p. 221; X, 1863, p. 412, etc.; Sterki, V, NAUTILUS, 9, 1895, p. 91; 12, 1898, p. 18; Amer. Natural., 37, 1903, p. 103; Baker, F. C., Bull. Chicago Ac., 3, 1898 (passim); Conner, C. H., NAUTILUS, 21, 1907, p. 87.

GROUP A. WINTER BREEDERS.

Truncilla triquetra Raf. Found gravid by the writer repeatedly in the months of September and October.

Truncilla perplexa rangiana Lea. Winter breeder (Sterki, '95). Found gravid in September.

Micromya fabalis Lea. July–August (Lea, III, '42).

Lampsilis ventricosa Barn. Winter breeder (Sterki, '95); autumn (Lea, III, '42); March, October (Lea, *ibid.*). Found gravid by the writer in all months from May to October. Marsupium partly empty (ovisacs extruded) on May 11; marsupium just beginning to be filled, July 30. (Breeds apparently "all the year round." See below.)

Lampsilis ovata Say. Autumn (Lea, III, '42); November (Lea, X, '63). Found gravid in August, September, October. (This is merely a variety of *L. ventricosa*.)

Lampsilis cariosa Say. October (Lea, II, '38). Found gravid in August.

Lampsilis ochracea Say. June and November (Lea, II, '38).

Lampsilis multiradiata Lea. Autumn (Lea, III, '42); July, August (Lea, *ibid.*). Found gravid in May, June, August, September, October. Only few specimens being found in June and July, it is uncertain whether there is an "interim" in the summer.

Lampsilis luteola Lam. March, July–August, October (Lea, III, '42); July (Baker, '98). I found gravid specimens in April, May, June, July, August, September, October. The species is a typical winter breeder, only the end of one season and the beginning of the next partly overlap in summer. In June, and chiefly in the beginning of July, sterile females (with the marsupium not charged) are much more frequent than in other seasons, while gravid females are very rare at the same time.

Lampsilis radiata Gmel. "All the year round" (Conner, '07); November (Lea, II, '38); May (Lea, X, '63). Discharge of ovisacs observed from November to March (Lea, X, '63).

Lampsilis ligamentina Lam. Winter breeder (Sterki, '95); autumn (Lea, III, '42). Found gravid by the writer in August, September, October, but not in July. Among numerous specimens collected, July 8, '07, July 3, 10 and 13, '08, not a single gravid female was discovered. The earliest date for the latter is August 3, but from that time on they were found regularly. This species pre-

fers the larger rivers, and thus no dates could be secured for the spring months, yet the "interim" in July is very sharply marked.

Lampsilis orbiculata Hildr. Autumn (Lea, III, '42). Found gravid in August and September.

Lampsilis recta Lam. Winter breeder (Sterki, '95); autumn (Lea, '42). Found gravid in July, August, September, October. No records at hand for the early summer.

Lampsilis nasuta Say. "All the year round" (Conner, '07); winter breeder (Sterki, '95); November (Lea, II, '38). I found this species gravid in September (Delaware River), and on June 2 and 3 (in Lake Erie), when numerous gravid females were found.

Lampsilis iris Lea. I found three gravid females on May 11.

Lampsilis parva Barn. Winter breeder (Sterki, '95); May and November (Lea, VII, '60). Extrusion of ovisacs observed by Lea (*ibid.*) in May.

Lampsilis (Proptera) alata Say. Winter breeder (Sterki, '95); autumn (Lea, III, '42). Found gravid end of August, September, October.

Lampsilis (Proptera) gracilis Barn. Winter breeder (Sterki, '95); autumn (Lea, II, '42). Found gravid in September.

Obovaria retusa Lam. Autumn (Lea, III, '42). I found a gravid female of this species on August 29, '08.

Obovaria circulus Lea. Winter breeder (Sterki, '95); autumn (Lea, III, '42); March, July-August (Lea, *ibid.*). I found gravid females on May 27, '08. Both forms *O. circulus* and *lens* are included here: they pass into each other.)

Obovaria ellipsis Lea. Winter breeder (Sterki, '95); autumn (Lea, III, '42).

Plagiola securis Lea. Autumn (Lea, III, '42). Gravid females not rare in September and October.

All species mentioned so far possess the "Lampsilis-type" of marsupium, *i. e.*, the posterior part of the outer gills is charged, at the period of gravidity, with eggs or embryos contained in distinct ovisacs. When not gravid, this part of the gills differs in structure from the rest, and females are always recognizable.

Cryptogenia irrorata Lea. Winter breeder (Sterki, '95); autumn (Lea, III, '42).

Marsupium very peculiar, but allied to the Lampsilis-type.

Ptychobranchus phaseolus Hildr. Winter breeder (Sterki, '95);

autumn (Lea, III, '42). Found gravid in August, September, October. A specimen found on May 11, '07, had most of the ovisacs discharged. None of the numerous specimens collected by the writer in June and July were gravid.

The peculiar shape of the marsupium of this species is well known.

In the following species, belonging to Group A, the marsupium occupies the whole of the outer gills, and while in *Strophitus* distinct "placentæ" (Sterki) are developed, such structures or ovisacs are not present in the rest.

Strophitus undulatus Say. Autumn (Lea, III, '42); March, October (Lea, *ibid.*); September, December (Lea, II, '38); discharge of placentæ observed in January and February (Lea, X, '63). I found this species gravid in the months of July, August, September, October; also in May. The latest date is May 22, '08 (one out of eleven individuals). Among numerous specimens collected on May 14 and May 27, '08, no gravid females were present, and during the month of June such were never found, although a good number of specimens were collected. The earliest date again is July 11. This gives an "interim" from the end of May to about the middle of July.

The eastern *S. undulatus* Say is absolutely undistinguishable from the so-called *S. edentulus* Say of the western waters.

Anodonta cataracta Say. Breeding season, eight months during the year; the interim May to October (Conner, '07); gravid in October and November (Lea, II, '38). I have seen gravid specimens collected on July 23, '08, and August 21, '08. The first date, no doubt, represents an exceptional case: there was only a single gravid individual among forty to fifty specimens. The other date (also a single individual, but only one found at that date) possibly marks the beginning of the season. At any rate it is very probable that the breeding season occasionally lasts longer than indicated by Conner, and may be extended in individual cases beyond May and may begin earlier than October, as is the case in other winter breeders.

Anodonta imbecillis Say. Autumn (Lea, III, '42); March (Lea, *ibid.*). Found gravid May 21, '08 (outlet of Lake Leboeuf, Erie county), and June 2, '08 (Lake Erie). This species is hermaphroditic, according to Sterki (NAUTILUS, 12, '98, p. 87).

Anodonta grandis Say. Autumn (Lea, III, '42); July, August (*ibid.*); October (Baker, '98). In Pennsylvania gravid females are frequent in August, September, October. I have found a single

gravid female on May 22, '08, out of a large number collected. Among numerous specimens collected on April 24, June 23, July 17 none were gravid. Thus the "interim" appears to extend over the month of May to July, with occasional individual exceptions.

Anodontooides ferussacianus Lea. Autumn (Lea, III, '42); October (*ibid.*). Found gravid in May, August and October. Among a dozen specimens, collected June 5, '08, in Little Shenango River, and among numerous specimens of the var. *subcylindraceus* Lea, collected on June 2, '08, in Lake Erie, not a single one was gravid. This would establish an interim at least in June. No dates are at hand for July.

Symphynota compressa Lea. Autumn (Lea, III, '42); March, September (Lea, *ibid.*). Gravid in May and beginning of June (June 2 in Lake Erie; only part of the outer gills charged). No gravid females taken during the rest of June, and during July, but only a small number of specimens was secured during this time. Beginning August 6, all through the month, and during September and October, gravid females were abundant. The color of the marsupium is very variable in this species: whitish, pink, orange, brown, and probably depends on the stage of development of eggs and embryos.

(To be continued.)

NOTES.

SHELLS NEW TO THE NEW ENGLAND FAUNA.—In a very small portion of shell-sand gathered by Mr. John Robinson at Hampton Beach, New Hampshire, I discovered a genus new to America, namely *Homalogyra atomus* Phil. A subsequent visit to this place enabled me to add a number of forms new to the New England Coast north of Cape Cod. Among those thus far determined is a *Scissurella*, probably *crispata* Flem., and *Cæcum pulchellum* Stimp. A few years ago Miss Marjorie C. Newell discovered specimens of *Tagelus devisus* Spengl. on Coffin's Beach, and Miss M. W. Brooks has detected a specimen of this species at Hampton Beach.

Later I hope to make an extended paper with illustrations of these and other new additions to our molluscan fauna.—EDWARD S. MORSE.